What is claimed is:

1. Spheroidal particles prepared from coal slag and coal fly ash having at least a hard outer shell and comprising SiO_2, Al_2O_3, Fe_2O_3, FeO, CaO, K_2O, and Na_2O.

2. The spheroidal particles of claim 1 wherein said coal slag particles comprise: SiO_2 in the range of about 20 to 60 weight percent; Al_2O_3 in the range of about 10 to 35 weight percent; Fe_2O_3 and FeO in the range of about 5 to 35 weight percent; CaO in the range of about 1 to 20 weight percent; and Na_2O and K_2O in the range of about 0.1 to 4 weight percent.

3. Spheroidal particles of claim 1 wherein said particles are in the range of 0.001 to 5 mm in size.

4. Spheroidal particles of claim 1 wherein said particles are in the range of 0.1 to 1 mm in size.

5. Spheroidal particles of claim 1 wherein said particles are coated with pigments, metals, lubricants, or hydrophobic materials.

6. Spheroidal particles of claim 1 wherein said particles are prepared from coal fly ash or finely divided coal slag, or further comprising added CaO, Al_2O_3, B_2O_3, BaO, SrO, Na_2O, K_2O, or mixtures thereof.

7. Spheroidal particles of claim 1 wherein said particles are hollow.

8. Spheroidal particles of claim 1 wherein said particles are magnetic.

9. A process for spherulizing irregularly shaped particles of coal fly ash or coal slag comprising the steps of:

(a) providing a drop tube having an upper portion, a central portion and a lower portion;

(b) delivering a feedstock of irregularly shaped particles of coal slag or coal fly ash to said upper portion of said drop tube in a manner such that said particles flow in a substantially vertical downward path through said feed tube as individualized particles;

(c) heating said particles to a sufficient temperature by providing heat to the outer surface of said central portion of said drop tube to cause at least the outer surface of said particles to melt such that a majority of said particles become spheroidal due to surface tension at the outer surface; and

(d) cooling said particles to prevent agglomeration.

10. The process of claim 9 wherein said feedstock is in the range of about 0.001 to 10 mm in size

11. The process of claim 9 wherein said feedstock is in the range of about 0.1 to 1 mm in size.

12. The process of claim 9 wherein said feedstock of coal fly ash or coal slag further comprises added SiO_2, Al_2O_3, FeO, Fe_2O_3, CaO, BaO, SrO, B_2O_3, Na_2O, K_2O or mixtures thereof, with the proviso that said coal slag is less than 0.1 mm in size.

13. The process of claim 9 wherein said feedstock of coal fly ash or coal slag further comprises materials which on heating provide H_2O, NO, NO_2, SO_3, CO_2, or mixtures thereof, with the proviso that said coal slag is less than 0.1 mm in size.

14. The process of claim 9 wherein the surface temperature on the inner wall of the drop tube is between about 1000°C to 1700°C.

15. The process of claim 9 wherein said coal slag or coal fly ash particles reach a temperature of about 1000°C to 1500°C.

16. The process of claim 9 wherein said spheroidal particles are subjected to a crushing step.

17. The process of claim 9 wherein said feedstock is delivered to said drop tube by gravity.

18. An apparatus for spherulizing particles comprising

(a) a substantially vertical elongate drop tube;

(b) a feed tube extending into the upper terminal portion of said drop tube and having a substantially closed lower terminal portion with a discharge port therein, the vertical axis of the discharge port being substantially on the vertical axis of said drop tube;

(c) feed means for supplying a feedstock to said feed tube;

(d) vibrating means for intermittently rapping said feed tube to cause discharge of said feedstock from said feed tube in a substantially vertical downward path through said drop tube as individualized particles;

(e) heating means proximate the outer portion of said drop tube and proximate a central portion of said drop tube, said heating means being capable of providing sufficient heat within said drop tube to cause the viscosity of at least the outer portion of said particles to become sufficiently low to allow the surface tension of said particles to spherulize said particles;

(f) cooling means to effect cooling of said spherulized particles such that said particles do not adhere to each other; and

(g) means for collecting said spherulized particles.

19. The apparatus of claim 18 wherein said drop tube is formed from ceramic or iron-nickel-chromium alloy.

20. The apparatus of claim 19 wherein said ceramic is fused quartz, aluminum oxide, or silicon carbide.

21. The apparatus of claim 18 wherein said feed tube is formed from ceramic or refractory metal.

22. The apparatus of claim 21 wherein said ceramic is borosilicate glass, quartz, silicon carbide or alumina.

23. The apparatus of claim 21 wherein said refractory metal is iron-nickel-chromium alloy or platinum.

24. The apparatus of claim 18 wherein said feed tube or said drop tube is lined with chrome oxide, magnesium oxide, zirconium oxide, silicon nitride, silicon carbide, or mixtures thereof, or platinum or platinum-gold alloy.

25. The apparatus of claim 18 wherein said feed tube or said drop tube is in a non-oxidizing atmosphere and is formed from or lined with graphite or boron nitride.

26. The apparatus of claim 18 wherein said discharge port is circular, polygonal, elongate, an array of holes, a bare wire screen, or a ceramic coated wire screen.

27. The apparatus of claim 18 wherein said feedstock comprises irregularly shaped particles.

28. The apparatus of claim 27 wherein said feedstock is coal slag or coal fly ash.

29. The apparatus of claim 18 wherein said vibrating means is a magnet proximate said feed tube and an intermittently powered coil surrounding said drop tube proximate said magnet.

30. The apparatus of claim 18 wherein said vibrating means is a solenoid.

31. The apparatus of claim 18 wherein said heating means is radiant heat, convection heat, induction means, or dielectric means.

32. The apparatus of claim 31 wherein said radiant heat is provided by an electric heating element or gas fired or particle burning heating elements encircling the drop tube.

33. The apparatus of claim 31 wherein said convection heat is provided by direct flame or preheated air.

34. The apparatus of claim 18 wherein said feed means is a gravity feed.

35. A feed system for feeding irregularly shaped particles comprising:

(a) a feed tube oriented substantially vertically and having a substantially closed lower terminal portion with a discharge port therein;

(b) feed means for supplying a feedstock of irregularly shaped particles to the feed tube; and

(c) vibrating means for intermittently rapping the feed tube to cause discharge of the feedstock from the feed tube through said discharge port in a substantially vertical downward path as individualized particles.

36. The feed system of claim 35 wherein said feed tube is formed from ceramics or refractory metals.

37. The feed system of claim 36 wherein said ceramic is quartz, borosilicate glass, silicon carbide or alumina.

38. The feed system of claim 36 wherein said refractory metal is iron-nickel-chromium alloy or platinum.

39. The feed system of claim 35 wherein said feed tube is lined chrome oxide, magnesium oxide, zirconium oxide, silicon nitride, silicon carbide, or mixtures thereof, or platinum or platinum-gold alloy.

40. The feed system of claim 35 wherein said feed tube is in a non-oxidizing atmosphere and is formed from or lined with graphite or boron nitride.

41. The feed system of claim 35 wherein said discharge port is circular. polygonal, elongate, an array of holes, a bare wire screen, or a ceramic coated wire screen.

42. The feed system of claim 35 wherein said feedstock is coal slag or coal fly ash.

43. The feed system of claim 42 wherein said feedstock particles are in the range of about 0.001 to 10 mm in size.

44. The feed system of claim 35 wherein said vibrating means is a magnet proximate said feed tube and an intermittently powered coil surrounding said feed tube proximate said magnet.

45. The feed system of claim 35 wherein said vibrating means is a solenoid.

46. A method of using the feed system of claim 35 wherein irregularly shaped particles are fed to said feed tube by gravity.

47. The method of claim 35 wherein said rapping is carried out at a sufficient rate and energy to cause said particles to discharge from said discharge port at a substantially continuous rate as individualized particles.

48. A process for feeding irregularly shaped particles comprising the steps of:

(a) feeding irregularly shaped particles to a feed tube oriented substantially vertically and having a substantially closed lower terminal portion with a discharge port substantially centered on the vertical axis of said feed tube;

(b) intermittently rapping said feed tube to cause said particles to discharge from said feed tube in a substantially vertical downward path as individualized particles.

49. The process of claim 48 wherein said rapping is carried out at a rate and energy sufficient to cause the particles to discharge at a substantially continuous rate.

50. The process of claim 48 wherein said discharge port is circular. polygonal, elongate, an array of holes, a bare wire screen, or a ceramic coated wire screen.

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